Explanation of Significant Differences
Brookhaven National Laboratory Site
Upton, New York

INTRODUCTION

In accordance with Section 117(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and Section 300.435(c)(2)(i) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), if the United States Department of Energy (DOE), the United States Environmental Protection Agency (EPA), and the New York State Department of Environmental Conservation (NYSDEC) select a remedial action and, thereafter, they determined there is a significant change with respect to that action, an explanation of significant differences and the reasons for such changes must be published.

The Operable Unit (OU) III Record of Decision (ROD) was issued in June 2000 with regard to the Brookhaven National Laboratory (BNL) Superfund site, located in Upton, Suffolk County, New York. The remedy selected called for, among other things, additional characterization and installation of groundwater monitoring wells in the Magothy Aquifer. Limited characterization had been performed when the ROD was written. The ROD stated that, when the characterization and monitoring were complete, the need for a Magothy remedy would be evaluated by DOE, EPA, and NYSDEC. The ROD went on to state that if a remedy for the Magothy Aquifer was necessary, either the ROD would be modified or another decision document would establish the selected action. In either case, the public will have an opportunity to review and comment in accordance with CERCLA.

The remedy for OU III also called for installing extraction wells, using ion exchange to remove strontium-90 from the extracted groundwater, and on-site discharge of the clean water. The ROD stated that "Before implementation of the remedy, a pilot treatability study will be performed to evaluate the effectiveness of extraction and treatment. The final remedy may be potentially be modified based on the results of this study."

The pilot study has been performed. The study demonstrated that strontium-90 can be removed from the groundwater. However, the cost of treatment is much greater than originally assumed in the ROD.

This Explanation of Significant Differences (ESD) describes the remedy selected for the Magothy Aquifer, and the changes proposed for the on-site strontium-90 contaminated groundwater.

The remedy for the Magothy calls for:

1) Continued operation of the existing or recently installed extraction wells as part of the Upper Glacial treatment systems that provide capture of Magothy volatile organic compound (VOC) contamination.
2) Installation of two additional off-site Magothy extraction wells; one on Stratler Drive (south of Carleton Drive), and one at the Industrial Park East location to prevent migration of high concentrations of VOCs through holes in the brown clay and into the Magothy Aquifer.
3) Continue to monitor and evaluate the data to ensure protectiveness.
4) Institutional controls and five-year review.

The remedy for strontium-90 calls for:

1) Installation of extraction wells using ion exchange to remove strontium-90 from the extracted groundwater, and on-site discharge of the clean water.
2) Operation of the system to minimize plume growth and meet drinking water standards within 70 years
3) Continued operation of the existing extraction wells as part of the Chemical Holes plume, minimize plume growth, and meet drinking water standards within 40 years.
4) Continue to monitor and evaluate the data to ensure protectiveness.
5) Institutional controls and five-year review.

This ESD also presents the additional projected costs resulting from the Magothy remedy identified above, and the cost information resulting from new strontium-90 data obtained since the selection of the remedy in 2000. The clean up goals for the strontium-90 groundwater plumes remain the same, but the time to attain the goals increases due to the inability of currently available technology to cost effectively attain the groundwater goals within a 30 year period.

This ESD and other relevant documents will become part of the Administrative Record file for the BNL site. The entire Administrative Record for BNL includes, among other things, the ROD and other relevant documents. These documents are available for review at the following locations:

Longwood Public Library
800 Middle Country Road
Middle Island, NY 11953
Phone: (631) 924-6400

Mastics-Moriches-Shirley Community Library
407 William Floyd Parkway
Shirley, NY 11967
Phone: (631) 399-1511

Brookhaven National Laboratory Research Library
Technical Information Division
Building 477A
Upton, NY 11973
Phone: (631) 344-3483

U.S. EPA — Region II Administrative Records Room
290 Broadway, 16th floor
New York, NY 10007
Phone: (212) 637-3185

The changes in the OU III remedy; 1) from characterization of the Magothy Aquifer to active treatment at two additional locations, and the anticipated increase in the cost of the remedy, and 2) the anticipated increase in the cost and time of the strontium-90 pump and treat remedy; as presented in this ESD, are not considered by DOE, EPA and NYSDEC to have fundamentally altered the remedy selected in the ROD. The remedies remain protective of human health and the environment and comply with federal and state requirements that were identified in the ROD.

Should there be any questions regarding this ESD, please contact:

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SUMMARY OF SITE HISTORY, CONTAMINATION PROBLEMS, AND SELECTED REMEDY

Site History

BNL is a federal research facility owned by DOE. The 5,300-acre site is located in Upton, Suffolk County, New York, about 60 miles east of New York City. The EPA-designated sole source aquifer beneath BNL has three water-bearing units: the Upper Glacial, the Magothy, and the Lloyd Aquifers. These units serve as the primary source of drinking water for Nassau and Suffolk Counties.

In 1989, the BNL site was included on EPA's National Priorities List because of soil and groundwater contamination that resulted from past operations. The lead agency for remedial action at BNL is DOE. The DOE, EPA, and NYSDEC then entered into a Federal Facilities Agreement that became effective in May 1992 that set the framework for the cleanup activities. To effectively manage remediation of the BNL site, 30 Areas of Concern (AOCs) were identified and divided into discrete groups called Operable Units (OUs), and Removal Actions. The BNL site is divided into six OUs. OU III was

developed to address groundwater contamination in the central and southern portion of the site and in the off-site areas where groundwater contamination has migrated.

Contamination Problems

The 1999 Remedial Investigation and Feasibility Study (RI/FS) for OU III identified on- and off-site groundwater contaminated with VOCs; and tritium and strontium-90 in groundwater on-site. The clean-up objectives that were subsequently developed to address this contamination are: to meet the drinking water standards in groundwater for VOCs, strontium-90 and tritium; complete the cleanup of the groundwater in a timely manner; which for the Upper Glacial Aquifer the goal is 30 years or less; and, prevent or minimize further migration of VOCs, strontium-90, and tritium in groundwater.

Due to operations of facilities and past waste disposal and waste handling practices, groundwater has been contaminated with strontium-90 at several locations. There are concentrated areas of strontium-90 contamination at four on-site areas: the Chemical Holes area, the Waste Concentration Facility (WCF), the Brookhaven Graphite Research Reactor (BGRR), and the Pile Fan Sump area.

Limited characterization of the Magothy Aquifer was performed prior to the OU III ROD. High concentrations of VOCs were identified in the Industrial Park and south of Carleton Drive. However, the lateral and vertical extent of contamination was not delineated.

Selected Remedy

Based on the results of the RI/FS, a ROD was issued by DOE in June 2000 that selected a remedy for OU III.

The remedy selected in the ROD that pertains to the Magothy Aquifer is as follows:

"At present, limited characterization has been performed in the Magothy, so additional characterization and installation of groundwater monitoring wells are planned. This work will be done during the design of the remedy, and will be included in the site records. When this characterization and monitoring is completed, the need for a remedy for the Magothy Aquifer, will be evaluated by DOE, EPA, and NYSDEC. If a remedy for the Magothy Aquifer is necessary, either this Record of Decision will be modified or another decision document will establish the selected action. In either case, the public will have an opportunity to review and comment in accordance with CERCLA".

The OU III ROD also acknowledges that VOCs could migrate into the Magothy Aquifer due to the absence of the Magothy brown clay at certain locations. One of these areas, located on-site at Middle Road, includes a treatment system designed to capture the deep VOCs. This is stated in the ROD as:

"In addition to these activities, the selected remedy, Alternative V10C, includes a groundwater treatment system at BNL's Middle Road to prevent migration and further contamination of the deeper Magothy Aquifer." A component of two other Upper

Glacial Aquifer treatment systems identified in the ROD is operation of the existing and recently installed extraction wells that also provide capture of Magothy contamination. These two extraction wells are located on-site at the southeast boundary and off-site at the airport. These three wells at Middle Road, the southeast boundary, and the airport, were installed within the uppermost portion of the Magothy as part of the Upper Glacial Aquifer treatment systems, in accordance with the ROD.

The remedy selected in the ROD that pertains to strontium-90 is as follows:

"The selected remedy, alternative S5a, involves installing extraction wells and using ion exchange to remove strontium-90 from the extracted water and on-site discharge of the clean water. Details of the specific number of treatment systems and locations needed to meet the cleanup objectives will be determined during the design process. Before implementation of the remedy, a pilot treatability study will be performed to evaluate the effectiveness of extraction and treatment. The final remedy may potentially be modified based on the results of this study. Residuals that contain Sr-90 will be disposed of off-site."

Post-ROD Magothy Characterization

Between April 2000 and August 2002 twenty-two vertical profiles and thirteen monitoring wells were installed and sampled into the Magothy Aquifer. This information, along with pre-existing data (including fifteen monitoring wells), helped delineate both the horizontal and vertical extent of Magothy impacts. A summary of the investigation and results are presented below:

Location	Max. TVOC[a] (ppb[b])	Primary VOCs	Results
Western Boundary on-site	<5.0	NA	Magothy not impacted. Two monitoring wells serve as adequate outpost/sentinel wells for Suffolk County Water Authority William Floyd wellfield.
Middle Rd and South Boundary on-site	340	PCE, CCl4	VOCs identified in upper 20 to 40 feet of Magothy at Middle Road area where brown clay is absent. TVOCs also detected at approximately 2,000 ppb in 1999 in lower portion of Upper Glacial. VOCs not detected at south boundary beneath the clay.
North Street off-site	50	TCE	Low TVOC concentrations have been detected in localized areas in the upper 30 feet of Magothy below hole in brown clay and downgradient near Vita Drive where clay exists. Leading edge of contamination is around Moriches Middle Island Road.
North Street East off-site	30	11-DCA, 11-DCE	Low TVOC concentrations have been detected at the BNL south boundary to North Street below the brown clay at approximately 40 to 150 feet in the upper Magothy. Tritium also co-located with VOCs upwards of 4,660 picoCuries/liter (pCi/l) (13,600 pCi/l detected in 1998).
Industrial Park East off-site and S boundary	570	TCA, CCl4	Lower VOC concentrations on-site (less than 50 ppb) and higher (more than 500 ppb) off-site in the Industrial Park where brown clay is absent. Magothy and Upper Glacial contamination is contiguous in Industrial Park.
South of Carleton Dr. off-site	7,200	CCl4	High VOC concentrations just south of Carleton Drive where brown clay is absent. Contamination is contiguous between Magothy and Upper Glacial Aquifer.

[a] Total Volatile Organic Compounds
[b] parts per billion

Most of the sub-areas investigated correspond to locations where the Magothy brown clay is absent (or a hole exists in the clay layer) thereby providing the mechanism for migration from the Upper Glacial Aquifer downward into the uppermost horizon of the Magothy Aquifer. The impacted groundwater in the overlying Upper Glacial Aquifer is considered to be the source of the Magothy contamination. Fate and transport modeling was also performed to project the estimated extent and duration of VOC impacts to the aquifer over time. Further details of the investigation results are presented in the final Magothy Characterization Report (May 2003).

Due to the public water hook-ups in the area south of BNL there are no current receptors associated with this plume. However, seven homes have not been hooked-up to public water and are still operating private wells. It is highly unlikely that the private wells are screened in the Magothy (Note: BNL/DOE formally follows–up annually with the seven known homeowners that are not connected to public water offering them free annual testing of their private drinking water well. The Suffolk County Department of Health Services is copied on the letters and will continue to be kept informed.) Based on modeling projections, no other pathway for exposure to groundwater is expected for approximately 100 years when the groundwater discharges into the Carmans River.

DESCRIPTION OF SIGNIFICANT DIFFERENCES AND THE REASONS FOR THOSE DIFFERENCES

This ESD to the June 2000 OU III ROD is needed to document changes to the Magothy Aquifer remedy and the on-site strontium-90 remedy. For the Magothy this includes:

- The modification of the OU III ROD to document the selected action of active treatment of the Magothy VOC contamination and associated costs, and
- Provide the public with an opportunity to review and provide feedback

As a result of the post-ROD additional characterization of the Magothy Aquifer identified above, DOE agreed that even though there are no known health risks associated with the plumes, they acknowledge the need to proactively treat the high VOC concentrations. This need was based on the following factors:

- Resource preservation of the sole source aquifer (consistent with the National Contingency Plan)
- Address the high concentrations now to limit plume growth
- Prevent substantial contamination of the Magothy which may warrant future treatment and require a longer and more costly cleanup
- Uncertainty in long term modeling projections

Three alternatives were evaluated for remediation of the Magothy Aquifer contamination. They are described in detail in the Magothy Supplemental Alternatives Analysis, dated March 2004 and summarized in the table below. Alternative 2 was the selected remedy to support the comprehensive remediation of the groundwater at BNL. This remedy includes continued operation of the existing and recently installed three extraction wells as part of the Upper Glacial treatment systems that provide capture of Magothy contamination. Two

additional off-site Magothy extraction wells on Stratler Drive (south of Carleton Drive) and at the Industrial Park East location are in the process of being installed to prevent migration of high concentrations of VOCs through the hole in the brown clay and into the Magothy Aquifer. Data from the monitoring wells will continue to be evaluated to ensure protectiveness. The total cost for this remedy is approximately $2,300,000. This cost is additional to those in the OU III ROD since a remedy for the Magothy Aquifer was not previously selected.

Magothy Alternatives

Alternative Number	Alternative Description	Years to Reach MCLs	Capital Cost (in $K)	O&M Cost (in $K)	Total Cost (in $K)
1	Existing 3* Magothy Wells and Additional Monitoring	110	400	1,100	1,500
2	Existing 3* Wells Plus 2 Additional Magothy Wells, and Monitoring	65	825	1,520	2,345
3	Existing 3* Wells Plus 7 Additional Magothy Wells, and Monitoring	30	3,900	11,290	15,190

* Note: Costs for the 3 existing Magothy extraction wells are not included here (they were previously covered in the OU III ROD costs as part of the Upper Glacial Aquifer systems)

The strontium-90 pilot study was performed and showed that groundwater could be treated to remove strontium-90 but at a significantly greater cost than was originally assumed in the ROD. The Feasibility Study and the ROD estimated that the costs to meet the clean up objectives for strontium-90 were $6,500,000[1]. These costs were for construction and operation and maintenance of two treatment systems to treat strontium-90 groundwater contamination. The first system was to treat strontium-90 contaminated groundwater located downgradient from the Chemical Holes area. The first treatment system has been constructed and is currently operating. The second treatment system has not been constructed and is to treat the Sr-90 contaminated groundwater downgradient from the WCF, BGRR, and the Pile Fan Sump area.

The cost of a high-flow treatment system to meet the cleanup objective (drinking water standards) in 30 years is now estimated to be $55,700,000. The substantial cost increase is due primarily to the high rate of required resin exchanges and the resulting waste management costs. Other pumping and resin use strategies were evaluated and a cost effective alternative has been identified that uses the same technology but at a lower flow rate.

[1] The present worth value is $5,800,000.

The differences between the ROD and this alternative are the time needed to achieve cleanup objectives and the cost. The original ROD goal was 30 years while the selected alternative achieves cleanup in approximately 40 to 70 years at an estimated cost of $14,000,000 (compared to the original ROD cost of $6,500,000[2]). The selected alternative actively treats the groundwater contamination, helps achieve cleanup of the aquifer to drinking water standards, and minimizes plume growth. See the table below for a summary of the strontium-90 change from the ROD to the ESD.

Due to the slow migration of strontium-90 in groundwater, and the slow migration time of the Magothy Aquifer, there is ample time to respond to unexpected conditions or deviations in monitoring data for both plumes. An effective groundwater monitoring well network is vital to assure that the selected remediation approaches are performing as expected and to identify deviations. Monitoring well data trends and plume movement will be evaluated on an annual basis. In addition, during the required five-year reviews, a comprehensive evaluation will be performed to ensure that the plume is behaving as expected and that the remediation approach continues to be protective of human health. During these reviews, DOE, EPA, and DEC will evaluate if modification of the remedy is needed to ensure this protectiveness. For the strontium-90 plume, sentinel wells will help monitor plume growth over time to ensure the plume remains within BNL property. Increasing trends of strontium-90 contamination in these wells will be evaluated, and if necessary, changes would be made. Changes could include installing additional monitoring wells or adding an additional extraction well.

Strontium-90 Summary

	OU III ROD	ESD
Scope	BGRR/WCF Plume: Pump and treat system Prevent or minimize plume growth Meet drinking water standards within 30 years Chemical Holes Plume: Pump and treat system Prevent or minimize plume growth Meet drinking water standards within 30 years	BGRR/WCF Plume: Pump and treat system Minimize plume growth Meet drinking water standards within 70 years Chemical Holes Plume: Pump and treat system Prevent or minimize plume growth Meet drinking water standards within 40 years
Performance	BGRR/WCF Plume: Meet drinking water standards in the aquifer through active remediation Chemical Holes Plume: Meet drinking water standards in the aquifer through active remediation	BGRR/WCF Plume: Meet drinking water standards in the aquifer through active remediation Chemical Holes Plume: Meet drinking water standards in the aquifer through active remediation
Cost	$6.5 million[2] $55.7 million (latest revised estimate based on ROD assumptions)	$14 million

[2] The present worth value is $5,800,000.

In accordance with the final BNL Land Use Management Plan, dated August 2003, the following institutional controls will continue to be implemented for the groundwater remediation program:

- Groundwater monitoring, including BNL potable supply systems, and SCDHS monitoring of Suffolk County Water Authority wellfields closest to BNL
- Five-year reviews as required by CERCLA will be conducted until cleanup goals are met and to determine the effectiveness of the groundwater monitoring program
- Prohibitions to the installation of new supply wells
- Public water service in plume areas south of BNL
- Prohibitions to the installation of new drinking water wells and other pumping wells where public water service exists (Suffolk County Sanitary Code Article 4)
- Property access agreements for treatment systems off of BNL property (deed transfer with property ownership change)

A certification will be included in the BNL Annual Groundwater Status Report that the institutional controls put in place for groundwater are unchanged from the previous certification. It will confirm that nothing has occurred that would impair the ability of the controls to protect human health or the environment or constitute a violation or failure to comply with any operation and maintenance requirements or BNL's Land Use Management Plan.

AFFIRMATION OF STATUTORY DETERMINATIONS

Considering the new information that has been developed, DOE, EPA, NYSDEC have determined that the remedy selected for the Magothy Aquifer and the changes to the strontium-90 remedy remain protective of human health and the environment, comply with federal and state requirements that are applicable or relevant and appropriate to this remedial action, and are cost-effective. In addition, the remedies utilize permanent solutions and alternative treatment technologies to the maximum extent practicable for this site.

DOE, EPA, NYSDEC believe that a change in the scope of the remedy has occurred in which a determination was made for: 1) the need for active treatment of the Magothy Aquifer and the installation of two additional off-site extraction wells; and 2) additional time needed to achieve cleanup objectives and increased cost for strontium-90. Nevertheless, they believe that this change does not fundamentally alter the remedy selected in the ROD or its appropriateness.

PUBLIC PARTICIPATION ACTIVITIES

In accordance with the NCP, a formal public comment period is not required when issuing an ESD. However, a notice of availability of this ESD will be made in a local newspaper, and there will be a public availability session relating to this ESD on TBD, 2004, from TBDpm to TBDpm at (location TBD). The ESD and other supporting

information will be made available for public review in the Administrative Record file at the locations identified at the front of this document.

In addition, as noted above, questions regarding this ESD may be directed to John Carter of DOE, whose mailing address, e-mail address, and phone number are set forth above.